Energy Transformation Taskforce

Registration and Participation Framework in the Wholesale Electricity Market

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Energy Transformation Taskforce

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Contents

1. Purpose

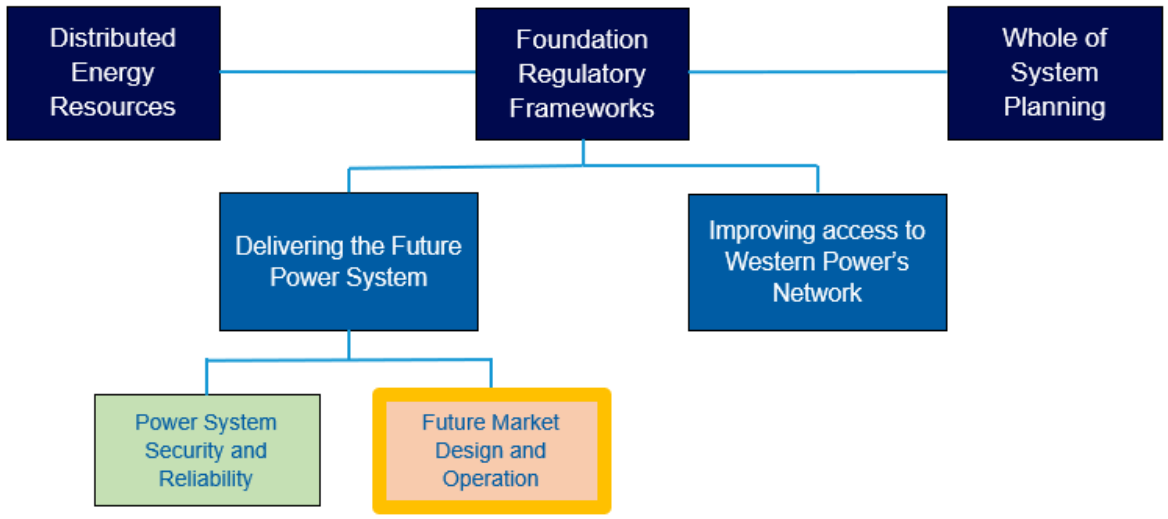
1.1 The Energy Transformation Strategy

This paper forms part of the work to deliver the Energy Transformation Strategy. This is the Western Australian Government's strategy to respond to the energy transformation underway and to plan for the future of our power system. The delivery of the Energy Transformation Strategy is being overseen by the Energy Transformation Taskforce (Taskforce), which was established on 20 May 2019. The Taskforce is being supported by the Energy Transformation Implementation Unit (ETIU), a dedicated unit within Energy Policy WA, a sub-department of the Department of Mines, Industry Regulation, and Safety.

More information on the Energy Transformation Strategy, the Taskforce, and ETIU can be found on the Energy Transformation website at www.wa.gov.au/organisation/energy-policy-wa.

This paper is prepared as part of the Future Market Design and Operation project (highlighted in Figure 1) within the Foundation Regulatory Frameworks work stream of the Energy Transformation Strategy.

Figure 1: Energy Transformation Strategy workstreams



The Future Market Design and Operation project is undertaking improvements to the design and functioning of the Wholesale Electricity Market (WEM). These include:

- modernising WEM arrangements to implement a security-constrained economic dispatch (SCED) market design that optimises the benefits of the introduction of constrained network access for Western Power's network; and
- implementing a new framework for acquiring and providing essential system services (ESS).[1]

[1] ESS are currently referred to in the WEM Rules as Ancillary Services. These services are being re-named ESS to reflect their growing importance in maintaining power system security as consumption patterns change and the power system transitions to higher levels of asynchronous intermittent generation.

1.2 The purpose of this paper

This paper outlines the framework and processes for the registration and participation of various entities in the WEM.

The paper draws on Taskforce decisions outlined in related information papers published to date as part of the Energy Transformation Strategy:[2]

- *Information Paper: Foundation Market Parameters,* endorsed by the Taskforce in August 2019
- *Information Paper: Energy Scheduling and Dispatch*, endorsed by the Taskforce in July 2019
- *Information Paper: Frequency Control Essential System Services*, endorsed by the Taskforce in August 2019
- *Information Paper: Essential System Services - Scheduling and Dispatch*, endorsed by the Taskforce in August 2019
- *Information Paper: Foundation Settings for Market Settlement*, endorsed by the Taskforce in September 2019
- *Information Paper: Market Settlement - Implementation of Five-Minute Settlement, Uplift Payments and Essential System Services Settlement* endorsed by the Taskforce in December 2019.

These information papers have focussed on how energy and ESS will be procured, scheduled, dispatched (where applicable), settled, and cost-recovered under the new market arrangements.

The purpose of this paper is to outline the registration and participation framework which will govern the application of various rule obligations on different types of participants and facilities under the new WEM arrangements, to be implemented on 1 October 2022. The paper outlines a taxonomy (i.e. classification of participant and facility classes) which facilitates the operationalisation of the procurement, scheduling and dispatch, and settlement decisions made by the Taskforce to date. The taxonomy also considers how to facilitate the participation of new types and configurations of technologies in the WEM, such as energy storage and distributed energy resources (DER).

The matters discussed in this paper have been consulted-on with the industry at the Transformation Design and Operations Working Group meeting held on 12 February 2020. The industry has supported the principles underpinning the registration and participation framework, and appreciated the Taskforce's intent to minimise unnecessary administrative burden by automatically transitioning existing registered facilities to the new registration framework, where relevant. Further consultation is planned with Market Participants with Intermittent Loads to discuss transitional arrangements for their Facilities. Further consultation will also be undertaken on elements of detailed design relating to the participation of new technologies (particularly storage and DER) via work in the Improving Access to the Western Power Network and DER work streams.

[2] These papers are available at: http://www.energy.wa.gov.au/government/document-collections/taskforce-publications

2. Registration taxonomy

2.1 Background

The WEM Rules require various participants to register in different classes to ensure obligations can be placed on individual participants or a group of participants with similar characteristics (in respect of the facilities they own, operate or control). The requirement to register principally exists for legal reasons to enable the application of the WEM Rules, in particular, enforcing centralised scheduling and dispatch of facilities by AEMO. It also provides information to new and existing industry participants about their WEM Rule obligations.

2.1.1 Existing participant and Facility Class definitions

The existing WEM participant and Facility Classes were defined based on then-conventional assumptions about the power system, namely:

- generation systems were largely synchronous and dispatchable (or controllable) in nature and connected to the high-voltage transmission system (as opposed to the lower-voltage distribution system);
- controllable synchronous generation would provide Essential System Services (ESS), such as contingency reserve and regulation; and
- power flow at facilities was largely unidirectional, with flow occurring from the high voltage transmission network to the lower voltage distribution network.

The existing registration framework outlines the concept of a Rule Participant which identifies entities that are required to comply with specific WEM Rule obligations, and are required to report any non-compliance under the WEM Rules to the Economic Regulation Authority (ERA). Table 2.1 below outlines the Rule Participants as currently defined in the WEM Rules.

Table 2.1: Rule Participant class definitions under existing WEM Rules

Rule Participant class (WEM Rule 2.28.1)	**Description**
Network Operator	A person who owns, controls or operates a transmission system or distribution system which forms part of the South West Interconnected System (SWIS), or is electrically connected to that system
Market Generator	A person who owns, controls or operates a generation system which has a rated capacity that equals or exceeds 10 megawatts (MW) and is electrically connected to a transmission system or distribution system which forms part of the SWIS, or is electrically connected to that system. A person who owns, controls or operates a generation system under 10 MW may optionally register as a Market Generator. Considered a Market Participant as defined in Chapter 11 of WEM Rules.

Rule Participant class (WEM Rule 2.28.1)	Description
Market Customer	A person who sells electricity to Contestable Customers in respect of Facilities electrically connected to a transmission system or distribution system which forms part of the SWIS, or is electrically connected to that system, must register as a Rule Participant in the Market Customer class, or A person who intends to sell electricity to Customers in respect of Facilities electrically connected to a transmission system or distribution system which forms part of the SWIS, or is electrically connected to that system, may register as a Rule Participant in the Market Customer class. Considered a Market Participant as defined in Chapter 11 of WEM Rules.
Ancillary Services Provider	A person who intends to enter into an Ancillary Service Contract with System Management and who is not registered in any other Rule Participant Class. Not considered a Market Participant.
AEMO[3]	• Australian Energy Market Operator • System Management • System Operator

Market Generators and Market Customers are a sub-set of Rule Participants that are also grouped together under the defined term Market Participants. Market Participants hold obligations in respect of their Facilities. Therefore, Market Participants must register their facilities under the relevant Facility Class. Table 2.2 outlines the existing Facility classes.

Table 2.2: Facility and Facility Class definitions under existing WEM Rules

Facility (WEM Rule 2.29.1)	Facility Class (WEM Rule 2.29.1A)	Description
Transmission or distribution network	Network	Transmission or distribution system (compulsory registration)
Generation system	Scheduled Generator	Non-intermittent generators ≥ 10 MW[4] (compulsory registration) Non-intermittent generators ≥ 0.2 MW but <10 MW (optional registration)
	Non-scheduled generator	Intermittent Generator ≥ 10 MW (compulsory registration) Intermittent Generator < 10 MW (optional registration) Non-intermittent generator (between 0.2 MW and 10 MW) that has not registered as a Scheduled generator (optional registration)

[3] The terms System Management and System Operator exist as legacy terms in the WEM Rules following the transferral of System Management functions from Western Power to AEMO in 2016. For all intents and purposes under the WEM Rules, System Management and System Operator functions are AEMO functions.

[4] 10 MW is the current minimum threshold of capacity for compulsory registration of generation facilities. The minimum threshold is further discussed in Section 3.1.

Facility (WEM Rule 2.29.1)	**Facility Class (WEM Rule 2.29.1A)**	**Description**
Load[5]	Interruptible Load	Load that has equipment installed to cause it to be interrupted in response to under frequency situations
Demand Side Programme (DSP)	Demand Side Programme	Non-dispatchable Load or Interruptible Load that can be curtailed on request by the Market Customer, may register a Demand Side Programme

2.2 Case for change

The transition to increasing levels of asynchronous, intermittent generation (including distributed generation) and bi-directional facilities connected to the SWIS has necessitated the re-design of the WEM, including fundamental changes to how energy is scheduled and dispatched and how ESS are defined, procured and dispatched.

Contrasting with the past when a technology, identified through its specific Facility Class could perform only a singular function and provide only a narrow set of services in the market, new technologies and facility configurations can perform a multitude of functions in the power system. This change has altered the relationship between the classification framework for facilities and the services they can provide in the market.

These changes mean that the existing WEM registration taxonomy is no longer fit-for-purpose. Retaining the existing facility classes and registration processes would impede the ability for new technologies, such as storage and DER, to participate under new market arrangements.

Examples of the shortcomings of the existing registration framework are as follows:

- Facilities can only register in one of the existing Facility Classes (see Table 2.2). These Facility Classes were specified assuming facilities would have primarily uni-directional energy flow. This inflexibility in the current framework restricts the manner in which bi-directional facilities can participate in the WEM.
- Related to the above, Market Participants are grouped into Market Generators and Market Customers (see Table 2.1), under the assumption that Market Generators are associated with facilities which only inject power into the network and Market Customers are associated with connection points[6] which only consume. As a result, certain cost recovery calculations are associated with Market Participant type as opposed to being explicitly linked to facility behaviour. This can lead to inequities in cost recovery.[7]
- Ad-hoc categories like Ancillary Services Provider have been introduced to account for unexpected trading arrangements. These ad-hoc arrangements not only compromise the coherence of the overall framework, but can lead to inequities in cost recovery in a future where

[5] A load is defined under the WEM Rules as "a connection point at which electricity is delivered from a distribution system or a transmission system to a Rule Participant". Most loads are non-dispatchable in nature; however, a non-dispatchable load is not formally defined as a type of facility.

[6] The point at which a Market Generator, Market Customer, or Ancillary Services Provider is connected to the distribution or transmission network.

[7] For example, in the current WEM, only Market Customers fund capacity in the RCM through Individual Reserve Capacity Requirements (IRCR), even though Market Generators can consume energy for auxiliary load.

unconventional forms of market participation may become more common. For example, an Ancillary Services Provider is not considered a Market Participant, even though they actively trade in the WEM, albeit as an ESS only provider. This categorisation means that they are not liable to pay market fees, as the market fees are linked explicitly to Market Generator and Market Customer categories.

- Registration is currently a static process, whereby Market Participants register when they first commence trading or participating in the WEM. Participants are not required to amend their registration even when they make material changes to their facilities. For example, a wind farm registered as a Non-Scheduled Generator would not be required to re-register as a Scheduled Generator, even if it installed a large grid-connected battery to firm its wind output.[8]

The energy transition and consequential market reforms, coupled with the existing shortcomings, necessitate redefining the WEM registration and participation framework.

2.3 Principles underpinning the framework

The purpose of the registration taxonomy and participation framework is to facilitate the operationalisation of the market design decisions for scheduling and dispatch of energy and ESS, ESS procurement, and settlement.

In addition to aligning with the WEM objectives and design principles for reform, the registration taxonomy and framework also aims to operationalise the following principles:

1. The taxonomy and framework should not restrict provision of specific services. Particularly, a facility's ability to provide a specific service (e.g. energy, ESS or reserve capacity) should be predicated on its technical characteristics and its ability to comply with the relevant accreditation or certification process, as opposed to being explicitly linked to its Facility Class definition. Practically, this would mean that any technology (including DER or grid-connected intermittent generation or storage) can provide a WEM service as long as it meets the relevant technical requirements.
2. The taxonomy and framework should be technology neutral, so as to not preclude technology types and configurations or business models which do not currently exist in the WEM (e.g. bi-directional resources such as storage, hybrid (storage plus intermittent), and virtual power plants (e.g. aggregated DER)).
3. Cost recovery of WEM products and services should not be explicitly linked to a participant or facility type, but should instead reflect the extent to which the relevant facility contributed to the need for that product or service.

2.4 The new registration framework

2.4.1 Taxonomy

Rule Participants

Rule Participants are entities that have obligations under the WEM Rules and must demonstrate compliance with those obligations. Market Participants are a subset of Rule Participants that trade services in the WEM and have financial obligations as part of market settlement.

[8] Under such a scenario, the wind farm would not be subject to the same dispatch compliance obligations as a Scheduled Generator, even though it is able to control its output to meet a specified dispatch target.

As set out in section 2.1.1, current Rule Participant categories include Market Generator, Market Customer, Ancillary Services Provider, Network Operator, AEMO, System Management and System Operator.

It is becoming less relevant to differentiate between the Market Customer and Market Generator and Ancillary Services Provider Rule Participant categories as:

- the types of technology on the power system are changing, and the traditional distinction between a Market Customer who consumes electricity and a Market Generator who produces electricity is becoming less relevant; and
- financial obligations such as cost-recovery for ESS will no longer be explicitly linked to a participant type (e.g. only Market Customers paying for Contingency Lower reserve), but instead will reflect the extent to which a Facility (registered to a Market Participant) contributed to the need for the relevant product or service by producing or consuming in a given trading interval.

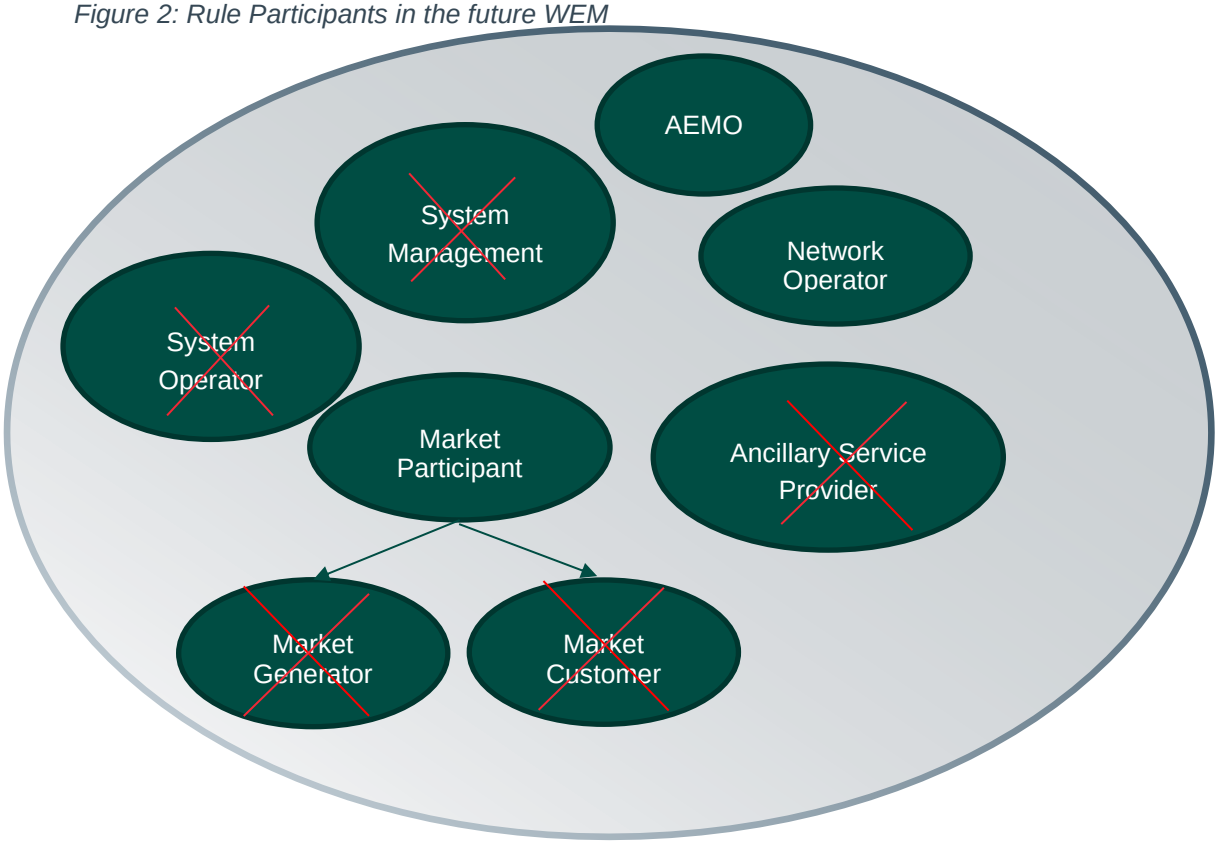
Reflecting this, a new 'Market Participant' class will be created to replace the existing Market Generator, Market Customer and Ancillary Service Provider classes. This category will denote a participant who provides or consumes a WEM product or service (i.e. any participant that is part of the financial settlement process). A Market Participant will hold obligations in respect of its Facilities. Therefore, a Market Participant must register its Facilities – types of facilities that can be registered in the WEM are identified in the section below.

The categories of System Management and System Operator will be removed, and any obligations for those Rule Participants will be subsumed into the 'AEMO' category, reflecting the current governance arrangements in the WEM.

No change is required to the Network Operator class.

Figure 2 illustrates the changes to Rule Participant classification.

Figure 2: Rule Participants in the future WEM



Facility types

Under the WEM Rules, a facility is equipment that must be registered by a Rule Participant to participate in the WEM. This fundamental concept of a facility will be retained, and the following are defined as 'Facilities' for the purposes of the WEM Rules:[9]

- a generation system;
- a transmission system;
- a distribution system;
- a storage system (including hybrid systems that include storage components); and
- a connection point at which electricity is delivered from a distribution system or a transmission system to a Rule Participant ('load').

This concept of a Facility is consistent with the existing WEM concept, with the addition of storage systems and the removal of Demand Side Programmes (DSPs). DSPs have been removed from the new facility concept, but will be retained as a Facility Class (see Table 2.4). A DSP is an aggregation of one or more connection points at which a load exists. As a connection point is already included in the definition of a facility, defining a DSP as a separate facility type is redundant.

There are two types of Rule Participants that will be required, as they are currently, to register their facilities. These are a Network Operator that must register a transmission or distribution system, and a Market Participant that must register any or a combination of a generation system, a storage system or a load. AEMO is a Rule Participant that is not required to register any Facilities.

Facility Classes

Facilities are classified into Facility Classes. In defining Facility Classes, it is important to note that the future WEM will comprise a combination of existing conventional and emerging technologies in configurations and using business models that do not exist today. Therefore, the new registration taxonomy will be based on the characteristics and attributes of facilities to group them into categories rather than the type of technology. Importantly, the purpose of classifying Facilities into Facility Classes is to ensure relevant rule obligations can be placed on Facilities with a similar set of characteristics. The classification does not restrict participation in any of energy or ESS markets – as long as a Facility is able to meet the relevant technical requirements for a service, the Market Participant can provide that service from that Facility.

Table 2.3 outlines the attributes that will be used to categorise different facilities into Facility Classes. Appendix A summarises existing and future technological configurations and their characteristics.

Table 2.3: Attributes used to categorise different facilities

Attribute	Comment
Controllability or the extent to which a facility can follow AEMO's	Controllability is the most important attribute when it comes to categorising a facility as it affects dispatch compliance obligations. Facilities can be: • Fully controllable: this facility can follow AEMO instructions to increase or decrease their output, and can control its output (within a tolerance band) over a specified

[9] These concepts do not require specific definitions in the Glossary of the WEM Rules, however they are identified as such in other relevant legislative instruments.

instructions to move up and down and control their output over a specified period.	period.[10] A fully-controllable facility is subject to dispatch compliance obligations (i.e. the facility must meet its dispatch target within a tolerance band). • Curtailable: this facility can follow AEMO instructions to decrease output only, and cannot control their output over a specified period. While a curtailable facility is provided a dispatch instruction based on its forecast output, it is not required to comply with that dispatch target due to its inability to control output.[11] However, when curtailed by AEMO, the facility must comply with the curtailment cap.[12] • Not controllable: this facility cannot follow an AEMO instruction. Such a facility generates or consumes based on its expected output and is not subject to dispatch compliance obligations.[13]
Direction of flow (primarily importing, primarily exporting or bi-directional).	The direction of flow can affect: • how offers are structured, and in particular, whether energy withdrawals are scheduled; • efficiency of incentives through allocation of costs of a service; and • how metering requirements are specified (see also Section 3.3).
Facility configuration	Whether or not the facility comprises a 'single facility' or an aggregation of multiple connection points (particularly on the distribution system). The latter configuration may become more commonplace in future as the participation of DER technologies increases.

Based on the above characteristics, the facility taxonomy set out in Table 2.4 will be created. Most facilities will be classified in either of Scheduled Facility, Semi-scheduled Facility or Non-scheduled Facility Class. In addition, two specific classes, DSP and Interruptible Load, are needed to account for the unique characteristics of these facility types.

Table 2.4: Facility Classes

Facility Class	Characteristics
Scheduled Facility	• Must be able to control its output within dispatch tolerance for a specified period. • Must comply with AEMO dispatch instructions within dispatch tolerance bands • Can offer both injections and withdrawals; however, a facility containing an Electric Storage Resource above the minimum threshold for registration will be required to schedule its withdrawals.
Semi-scheduled Facility	• Cannot control its output within dispatch tolerance bands for a specified period; however, must be able to curtail injection if directed. • Must comply with AEMO curtailment instructions. • Can offer both injections and withdrawals; however, a facility containing an Electric Storage Resource above the minimum threshold will be required to schedule its withdrawals.

[10] See Section 2.4.2 for further details on how controllability is defined.

[11] The cost recovery mechanism for Regulation Reserve will be key to incentivise semi-scheduled and non-scheduled facilities to improve the accuracy of their forecast output, and thus reduce their deviation from the dispatch target.

[12] For example, if a windfarm's expected output during a dispatch interval is 50 MW, but AEMO issues a dispatch instruction for 25 MW, then the facility must generate at or below 25 MW.

[13] Non-controllable facilities will be liable for ESS cost-recovery, similar to the other two type of facilities.

Facility Class	Characteristics
Non-scheduled Facility	• Cannot control or curtail its output in response to dispatch instructions and is a price-taker. • May be required to curtail output if directed by AEMO in exceptional characteristics.
DSP	• Primarily a Reserve Capacity Mechanism construct, and unique in terms of certification, monitoring (reserve capacity testing), and dispatch. • Can comprise one or more load connection points at one or more electrical locations which can curtail consumption with two hours' notice
Interruptible Load	• Can comprise one or more load connection points at the same electrical location which can respond to a frequency signal to shed load. An Interruptible Load provides Contingency Raise ESS, and no other service. • Cleared for contingency raise ESS on an "all or nothing basis". Unlike supply-side providers, an interruptible load facility's ESS quantity cannot be cleared partially.
Network	• Transmission or distribution system

Scheduled, Semi-scheduled or Non-scheduled Facilities could (theoretically) include any or all of[14]:

- a storage system (either as a standalone storage system or as part of a hybrid system);
- a controllable or 'Scheduled Load' component which offers energy withdrawals (or bids) into central market-clearing processes; or
- aggregated DER (e.g. virtual power plant).

The unique aspects of storage systems, scheduled loads and DER facilities mean that there has to be a mechanism to reference these facility types within the WEM Rules and Market Procedures so that differential obligations and exemptions can be specified. The following terms will be defined in the WEM Rules:

- 'Electric Storage Resource', to define a system or resource capable of receiving electric energy from the grid and storing it for later injection of electric energy back to the grid.
- 'Scheduled Load', to define an electricity-consuming resource or device or group of resources or devices (certified by AEMO) which is controllable for dispatch purposes.
- 'Small Aggregation', to define any facility which is aggregated across single or multiple connection points comprising DER.

Facilities that include an Electric Storage Resource, Scheduled Load or Small Aggregation may have unique obligations placed on them (or exemptions applied to them), which do not apply to other conventional facilities. The reason for unique obligations or exemptions on these facility sub-types is to respect their unique characteristics for the purposes of central market scheduling and dispatch for energy and ESS, while ensuring their participation does not compromise system security.

Examples of some obligations have been previously outlined in the *Information Paper: Energy Scheduling and Dispatch*.

[14] For example, a hybrid wind and storage facility could be classified as a Semi-scheduled Facility with an Electric Storage Resource component. Such a facility could participate in energy and ESS provision depending on its ability to control its output and respond to Dispatch Instructions.

2.4.2 Definition and determination of controllability

The concept of controllability is an important aspect of energy dispatch and relates to how accurately a facility can follow instructions provided by AEMO. A controllable facility can be more accurately relied upon by AEMO to schedule energy supply to meet demand. Controllability of facilities is therefore a factor in maintaining power system security and reducing the quantity of Regulation ESS required to be enabled to maintain electrical frequency. Moreover, a facility's ability to control output affects its dispatch compliance obligations as outlined in Table 2.3.

AEMO will determine a Facility's controllability and its Facility Class as part of the registration process. The detailed process will be set out in a Market Procedure using the following principles:

1. AEMO will determine a Facility's controllability based on how reliably it can follow AEMO's dispatch instructions within a tolerance range.
2. When determining reliability, AEMO will take into account (but not limited to):
    a. how accurately a Facility is able to follow a dispatch instruction;
    b. how frequently a Facility is able to follow a dispatch instruction within tolerance range (i.e. the facility's ability to match its forecast output accurately for a defined percentage of intervals); and
    c. the period of time over which the facility can control its output.
3. When determining whether a Facility is controllable, AEMO may consider (but not limited to):
    a. the size and/or nameplate capacity of different components of the Facility;[15]
    b. whether the Facility is primarily a supply-side or demand-side facility based on its components; and
    c. the fuel used (as that would determine variability of output).
4. A Market Participant can nominate a Facility Class which it wishes to register its Facility under; however, AEMO can assign a different Facility Class based on the factors outlined in the Procedure. For example, a 100 MW combined cycle gas turbine facility that can reliably control output within a tolerance range for a sustained period (subject to fuel availability) would not be allowed to register as a Semi-scheduled or Non-scheduled Facility. Likewise, a hybrid facility requesting registration in the Semi-scheduled Facility Class may be denied its request if AEMO determines the facility can control its output reliably and accurately.
5. AEMO will not unreasonably deny a facility registration request under a Facility Class, and will be required to justify its determination if different from the Market Participant's request.
6. AEMO will be required to define a monitoring and/or testing process to monitor the controllability of Facilities and re-classify them if controllability has changed.

[15] For example, when registering a hybrid system, AEMO would take into account the relative size of the intermittent component vis-a-vis the firming (e.g. storage) component. Hence, a 5 MW wind farm with a 15 MW battery would likely be considered a controllable and therefore Scheduled Facility, whereas a 15 MW windfarm with a 5 MW battery would likely be considered a Semi-scheduled Facility.

2.5 Transitional arrangements

Table 2.5 maps the existing facility classes to the new classes and summarises how existing registered facilities will be transitioned to the new taxonomy.

Table 2.5: Transition from existing to proposed facility classes

Existing Facility Class	New Facility Class
Scheduled Generator	All Scheduled Generators would automatically be registered as **Scheduled Facilities**. Intermittent generators[16] would have the option of registering as a Scheduled Facility subject to meeting controllability requirements
Non-scheduled Generator	Intermittent generators above the minimum threshold for registration would be automatically registered as **Semi-scheduled Facilities,** unless • the Market Participant self-nominates its facility to be registered as a Scheduled Facility. In this case, AEMO's new registration procedure will apply and AEMO would assess the facility's controllability to determine if it can be classified as scheduled. • the Market Participant adds a firming resource (e.g. storage). Here, AEMO's new registration procedure will apply and AEMO would review controllability to determine if the facility should be reclassified as scheduled with storage.
	Generators below the minimum threshold for registration that cannot follow dispatch instructions would be automatically registered as **Non-scheduled Facilities** unless the Market Participant self-nominates to register as a Scheduled or Semi-Scheduled Facility. In this case, AEMO's new registration procedure will apply.
Interruptible Load	Interruptible Load
Demand Side Programme	Demand-Side Programme[17]

All new connecting Facilities will be assessed as per the Market Procedure and assigned a relevant Facility Class.

[16] Although the term Intermittent Generator is not required for the purpose of scheduling and dispatch, it may need to be retained in the WEM Rules to define the concept of Reserve Capacity Obligation Quantity (RCOQ) for generators with an intermittent fuel supply (i.e., wind and solar).

[17] The terms DSP and Associated Load are relevant with respect to defining and registering a DSP and its Associated Loads for the purposes of RCM. These terms therefore may need to be retained in the WEM Rules.

2.6 Taskforce Design Decision – Taxonomy for registration

The Taskforce has endorsed the following taxonomy for registration purposes:

Category	Taxonomy
Rule Participant Class	• Market Participant • Network Operator • AEMO
Facility	• Transmission system • Distribution system • Generation system • Connection point (‘load’) • Storage system
Facility Class	• Scheduled Facility • Semi-scheduled Facility • Non-scheduled Facility • Demand Side Programme • Interruptible Load • Network
Facility sub-types	• Electric Storage Resource • Scheduled Load • Small Aggregation

- A Network Operator must register a transmission or distribution system.
- A Market Participant must register its Facility in a Facility Class.
- When registered in a Facility Class, a Facility can also contain facility sub-types that have unique obligations or exemptions placed on them for the purposes of central market scheduling and dispatch.
- AEMO will be required to document the process for determining a Facility’s Facility Class in a Market Procedure.
- AEMO will not unreasonably deny a Market Participant’s request to register a Facility in a particular Facility Class, however, AEMO’s determination will be final.

3. Other associated matters

3.1 Minimum threshold for registration

Market Participants are required to register their facilities above a certain size to facilitate centralised scheduling and dispatch, which is instrumental in ensuring power system security and economically efficient dispatch. The minimum threshold denotes the minimum capacity above which it is mandatory for a Facility to register in the WEM.

As the generation mix changes, there may be a need for different thresholds for different technologies or generators in different locations, as their impact on system security and system costs may be different.

3.1.1 Current arrangements

The minimum threshold for registration is currently set at 10 MW. That is, a person owning, controlling or operating a generation system which is under 10 MW is not required to register its facility in the WEM. The registration requirements under current WEM Rules are summarised in Table 3.1 below.

Table 3.1: Existing facility registration requirements

Generation Facility Class	Not intermittent		Intermittent	
	Mandatory	Optional	Mandatory	Optional
Scheduled Generator	Greater than 10 MW	Greater than 0.2 MW and less than 10 MW	N/A	N/A
Non-scheduled Generator	N/A		Greater than 10 MW	Greater than 0.005 MW and less than 10 MW

Despite the 10 MW threshold, the majority of small generators are registered in the WEM for the purpose of participating in the Reserve Capacity Mechanism.[18]

Table 3.2 below summarises small generators which are currently connected to the SWIS, categorised by WEM registration status.

Table 3.2: Small generation systems connected to the SWIS

	Registered	Not Registered	Totals
<5MW	1 (intermittent)	2	**3 (1 intermittent)**
5-7MW	1 (intermittent)	3	**4 (1 intermittent)**
7-10MW	7 (3 intermittent)	2 (1 intermittent)	**9 (4 intermittent)**
Total	**9 (5 intermittent)**	**7 (1 intermittent)**	**16 (6 intermittent)**

Source: Western Power

[18] Under clause 4.8.1 of the WEM Rules, a Market Participant may apply for certification of reserve capacity for a facility if that facility is a Registered Facility or intends to become a Registered Facility by the commencement date of its reserve capacity obligations.

Six of the seven unregistered facilities do not export to the WEM (i.e. are back-up or are intended to serve a load 'behind the meter'). Because of their relatively small size and limited export to the power system, the unregistered facilities are therefore unlikely to have a material impact on WEM outcomes.

Fifteen of the 16 facilities are connected to the lower-voltage distribution system (as opposed to the higher-voltage transmission system).

3.1.2 Principles – Minimum threshold for registration

In selecting an appropriate minimum threshold for registration as a Market Participant, the Taskforce has had three main areas of consideration:

1. *Market outcomes* (including power system security): The minimum threshold governs the extent to which AEMO has visibility of generation on the system. This visibility is required for the delivery of a secure power system as well as efficient market outcomes through scheduling of generation (as opposed to including smaller generation in the demand forecast). The threshold should also be set at a level that ensures that a facility of a size below the threshold tripping does not affect the Contingency Raise requirement. AEMO has advised that facilities sized below 10 MW tripping do not have a discernible impact on system frequency (insofar as it affects the procurement of Contingency Raise ESS).

   The extent to which market outcomes are compromised as a result of smaller generators not registering also depends on the number of unregistered smaller generators on the system. As indicated, in Table 3.2Table 3.2, this number is currently low. Hence, retaining the minimum threshold at 10 MW is unlikely to compromise market outcomes at present. However, in the future, if there is a substantially higher number of small (unregistered) facilities, this would not only compromise the accuracy of dispatch, but may also compromise power system security if these generators set a large enough contingency risk (e.g. a large number of small generators behind a single network element).

2. *Administrative complexity*: While having visibility of generation connected to the system is useful, requiring the registration of generation below a certain threshold comes with administrative costs which may outweigh any benefit. There may be less burdensome alternatives to market registration that would enable AEMO to manage the security risks associated with very small generators like rooftop solar photovoltaic (PV) systems (e.g. static registers and technical standards for rooftop solar PV systems). The Energy Transformation Strategy includes the development of a DER Register and a DER Roadmap. Matters being considered for inclusion in the DER Roadmap include technical standards on inverters for rooftop solar PV systems to assist system performance during a security event, and methods of improving visibility of DER on the SWIS to assist AEMO with accurate information regarding the performance of DER during power system events.

3. *Equity of cost recovery*: Facilities that are not registered in the WEM are unable to be captured by WEM Rule obligations, such as cost-recovery for ESS. While smaller facilities do not contribute to the need for Contingency Raise ESS, they do contribute to the Regulation ESS requirement because of their inherent variability of output. Connection points associated with rooftop solar PV systems contribute to Regulation ESS costs through payment to their retailers (who are currently registered in the WEM as Market Customers). Likewise, unregistered small generation systems which import would also be liable for regulation costs passed-through via their retailers. Therefore, the only unregistered facilities which are not making a specific financial contribution towards market-related costs are small generation systems which export. At present, there is only one such generation system (see Table 3.2Table 3.2), and this is unlikely to contribute a material amount to the overall Regulation ESS requirement.

3.1.3 Future arrangements

The Taskforce considered three options with respect to defining the minimum threshold for registration:

1. *Retain the 10 MW threshold*, but empower AEMO to review the threshold from time to time to assess whether it is still appropriate. For example, if in the future, the number of small transmission-connected facilities increases materially,[19] then this would adversely affect all three principles discussed above.
2. *Decrease the threshold to a lower level*. Decreasing the threshold to 5 MW would only affect five facilities, none of which export to the WEM (see Table 3.2).
3. *Defined 'soft' and 'hard' thresholds* (that is, thresholds between which a Facility may, or must be registered), with exceptions allowed based on the characteristics of individual facilities.

The Taskforce has selected the third option as it:

- provides AEMO with the flexibility to determine whether smaller generators between the soft and hard thresholds may pose enough of a system security risk such that they are required to register; and
- recognises the need for a differential threshold for technologies such as battery storage which can have very fast ramp rates and can switch from maximum charge to maximum discharge within one cycle (Hz).[20]

The Taskforce has determined the following for the minimum threshold for registration:

- Any Facility with a generation system with:
  - a 'nameplate' rating of below 5 MW; or
  - maximum injection capability of below 5 MW; or
  - maximum injection less maximum offtake of below 5MW

  will have a standing exemption from the requirement to register unless AEMO determines the Facility must register for the purposes of system security. Details on eligibility for and processes related to standing exemptions will be outlined in a Market Procedure, drafted by AEMO.
- Any Facility with a generation system with:
  - a 'nameplate' rating above 10 MW; or
  - maximum injection capability above 10 MW

  will be required to register for the purposes of being centrally dispatched. Additionally, any facility whose maximum injection less maximum offtake is above 10 MW in a single cycle will be required to register for the purposes of being centrally dispatched by AEMO. This would mean that any Facility with standalone storage systems with an export capability of 5 MW would need to register.
- Any Facility with a generation system with:
  - a nameplate rating between 5 MW and 10 MW; or
  - maximum injection capability between 5 MW and 10 MW

[19] For example, as a result of more small generators connecting, or an increasing incidence of self-supplying communities connecting via microgrids.

[20] For example, a battery storage facility with a nameplate rating of 5 MW can switch from 5 MW discharge to 5 MW charge, resulting in an instantaneous change of 'generation' of 10 MW.

may apply to AEMO for exemption from registering. Additionally, any facility whose maximum injection less maximum offtake is between 5 MW and 10 MW in a single cycle may apply to AEMO for exemption.

Application of the minimum threshold for Aggregated DER

Historically, the minimum threshold for registration has been interpreted in the context of the total installed capacity of a conventional grid-connected facility comprising a single unit or multiple units operated as a single station (e.g. wind farms and combined-cycle gas turbines). The installed capacity of such a generator is an accurate indicator of the facility's maximum injection capability.

In the future, aggregated DER facilities may comprise a combination of diverse technologies such as solar PV systems, batteries, electric vehicles, and smart appliances. Here, the minimum threshold should be defined with respect to the maximum injection capability of all energy injection by all technologies in the facility.

For example, consider a DER Facility comprising:

- a solar PV system with total nameplate rating of 5 MW;
- batteries, with single-cycle change (maximum change from charge to discharge) of 3 MW; and
- electric vehicles with total export capacity of 2 MW.

For the purposes of determining whether the facility is above or below the minimum threshold, the total capacity would be 10 MW (5+3+2). Specifically, the total capacity is not based on expected export (taking into account expected consumption of load), but on the maximum injection if all generating components were generating at full capacity with no load.

This approach is consistent with the conventional approach to interpreting the threshold as being an indicator of the facility's maximum injection capability.

3.1.4 Taskforce Design Decision – Minimum threshold for registration

The Taskforce has endorsed the following design decision:

Minimum threshold for registration

Facilities with generating systems with a nameplate rating, or maximum injection, or single cycle change (injection less offtake) of:

- at or above 10 MW will be required to register in a Facility Class;
- between 5 MW and 10 MW will be required to apply to AEMO for exemption from registering in a Facility Class; and
- below 5 MW may receive a standing exemption from registering in a Facility Class, unless AEMO determines the facility must register for system security purposes.

Interpretation of the minimum threshold for aggregated DER facilities

The nameplate rating of a DER facility will be defined as the maximum injection capability of the facility if all generating components were generating at full capacity with no load.

3.2 Definition of electrical location

The *Information Paper: Energy Scheduling and Dispatch* noted that locational nature of SCED, combined with co-optimisation of ESS, implies that under new market arrangements, aggregated facilities cannot be defined across diverse electrical locations.[21]

With respect to conventional grid-connected generation, the definition of electrical location can be interpreted as the injection point into the grid, i.e. the relevant zone substation (or transmission network identifier – TNI) at which the Transmission Loss Factor (TLF) for the relevant facility is defined.

By way of contrast, DER will be embedded in the distribution network and could be defined across multiple network connection points. Aggregation of such resources are described in Section 4 of this paper.

Electrical location in respect of DER must be defined in a manner that does not impede entry to ─ or participation in ─ the WEM. Electrical location for DER could be defined with respect to the 'grid-exit point' which the connection points map to. Grid exit points are not formally defined on the SWIS (due to the lack of a formal boundary between the higher-voltage transmission and lower-voltage distribution networks). However, as with grid-connected resources, the relevant zone substation, or TNI can be used to define the electrical location which the connection points map to.

Further details on electrical location would be defined in a Market Procedure to be developed by AEMO.

[21] While facilities can, subject to certain limitations, be aggregated across diverse network connections, they must inject into the same electrical location.

3.2.1 Taskforce Design Decision – Definition of electrical location

The Taskforce has endorsed the following design decision:

- For traditional grid connected facilities, the electrical location is the relevant zone substation (TNI) at which the facility's TLF is defined.
- For DER facilities, the electrical location is the relevant zone substation (TNI) that the distribution network containing the DER facility is connected to in normal network configuration.

3.3 Treatment of intermittent loads

A facility configuration which currently exists in the WEM is intermittent load, where a load is served by generation at its electrical location and is net metered (i.e. a meter that only records the net export or import quantity at the connection point). The current WEM Rules allow intermittent loads to be served by remote generation at a different electrical location to the load. However, there are no such intermittent loads currently registered in the WEM. Under new SCED market arrangements to be implemented on 1 October 2022, remote generation will not be allowed due to the locational nature of dispatch around power system constraints.[22]

An intermittent load can import and export and is net-metered. The net-metering arrangement can create some complexities and inefficient market outcomes with respect to energy and ESS scheduling and dispatch and settlement, particularly for intermittent loads with on-site generation of a size above the minimum threshold for registration (10 MW). Particularly, the Contingency Raise ESS risk associated with an intermittent load facility may be under-specified during ESS scheduling and dispatch if the generation and load do not trip together.

Under SCED, the Contingency Raise ESS requirement would be set by the largest contingency, which may be the output of the largest generating facility. If an intermittent load has net-metering only, its Contingency Raise ESS-related risk would be set by its net export. If the load does not trip at the same time as the on-site generation, then the facility-related risk would be under-estimated and Contingency Raise ESS reserve would be under-procured by AEMO. This is because the actual contingency risk is denoted by the gross output of the generating system (not the net-export). This is a material issue only if a generator with an intermittent load is large enough to set the contingency raise requirement. Existing intermittent loads do not have generation large enough to set this risk.

Additionally, existing intermittent loads introduce complexity into settlement systems and are associated with inequitable arrangements with regards to cost allocation. Particularly, intermittent loads which have on-site generation above the minimum threshold are exempt from registering their generation. All existing intermittent loads (including with generation below the minimum threshold) have specialised arrangements with respect to funding reserve capacity. These arrangements can lead to inequities in that facilities may not be paying their fair share of reserve capacity costs except in the circumstance when the embedded generator is not operating, and the load is consuming in full from the grid.

For this reason, the Taskforce has determined that while the concept of intermittent loads will be retained, changes will be made to ensure the associated generators do not adversely impact power system security and that Individual Reserve Capacity Requirement (IRCR) arrangements are less complex and more equitable:

[22] See Information Paper: Energy Scheduling and Dispatch.

- Intermittent loads with generation above the minimum threshold will be required to register in the WEM and be part of centralised scheduling and dispatch by AEMO. This means all intermittent loads with generation above the minimum threshold will be cleared through centralised dispatch when exporting.
- Intermittent loads with generation capacity above the minimum threshold can retain net-metering arrangements as long as the size of the on-site generation is not large enough to potentially set the Contingency Raise ESS risk. Under such circumstances, the load and the generation would need to register separately behind two separate connection points.
- Intermittent loads will fund reserve capacity costs based on their IRCR as measured by their net consumption.

Transitional arrangements may be considered for existing intermittent loads that are not able to be classified under a new Facility Class, subject to consultation with the relevant stakeholders.

3.3.1 Taskforce Design Decision – Intermittent loads

The Taskforce has endorsed the following design decision.

- Intermittent loads with generation systems above the minimum threshold will be required to register in a Facility Class
- Specialised arrangements for intermittent load IRCR will be removed; intermittent loads that register under new market arrangements will be liable for their full IRCR based on net consumption
- Existing intermittent loads may be required to register in an appropriate Facility Class, with consideration to be given to transitional arrangements.

4. Facility aggregation

4.1 Facility aggregation requirements

The *Information Paper: Energy Scheduling and Dispatch* defines 'offer granularity' as the level of detail at which information about each facility is made visible to the market clearing engine. In this context, an aggregated facility is defined as multiple generation systems at diverse network connection points (but at the same electrical location) which submit offers for the aggregation as a whole.

The *Information Paper: Energy Scheduling and Dispatch* further noted the following rules in respect of facility aggregation:

- Facility owners must provide data to AEMO for each individual Facility.
- Facility aggregation would be allowed at AEMO's discretion where the individual facilities inject at the same network location and:
  - none of the individual facilities will provide ESS, and the small size of the aggregation means it is unlikely to affect the quantity of ESS dispatched; or
  - capability to simultaneously provide energy and ESS from the individual facilities can be adequately described as an aggregated facility, and the small size of the aggregated facility means it is unlikely to affect the quantity of ESS dispatched; or
  - the relevant credible contingency is the loss of the network connection to all individual facilities simultaneously, rather than the loss of a single individual facility; or
  - the aggregated facility would comprise generation systems that are dependent on each other, such that there is a credible contingency of losing more than one individual facility at once (for example combined cycle generators).

The above aggregation rules were defined with traditional grid-connected generation systems in mind; for example:

- intermittent generators injecting at the same network location which must offer in as a single aggregated facility;
- combined cycle facilities, where one or more gas turbines are linked to a steam turbine are represented as a single aggregated facility; and
- multiple gas turbines injecting at the same network connection point, where it is operationally simpler for a facility owner to offer and be dispatched as a single facility.

AEMO's registration process would need to take the above requirements into consideration for facilities wishing to aggregate units. The detailed process for aggregation would be set out in a Market Procedure to be developed by AEMO.

While the aggregation requirements above also apply to an aggregated DER facility defined across diverse network connection points in the distribution network (at the same electrical location), there are certain complexities associated with DER facilities, which require consideration of new aggregation rules.

The participation framework for DER must contemplate new business models that do not currently exist in the WEM. Particularly, the framework should allow for retailers or third parties to aggregate DER and provide WEM services such as energy, capacity, and ESS. The over-arching policy framework and specific actions to be taken by Government in regard to DER aggregation will be

addressed further in the DER Roadmap. Further work is to be undertaken to define specific aggregation rules for DER.

5. Registration processes

5.1 Lifecycle approach to registration

Registration is largely a one-off process in the current WEM, in that registration processes (with the exception of standing data updates) apply only when a Facility is first registered. Once a Facility is registered in a specific class, that classification does not change.

Under new WEM arrangements registration will need to be an ongoing process from facility creation to deregistration. This is to ensure that AEMO has the information required to inform scheduling and dispatch while maintaining system security, and that necessary obligations apply to a facility through the operation of the WEM Rules. The Taskforce Design Decisions on the registration process are outlined below.

For participation in the RCM, the requirement for Market Participants to register their facility will not apply until the reserve capacity obligations apply, as per the current arrangements. By the time the reserve capacity obligations apply, the Facility will be required to have been registered in a Facility Class, following the appropriate procedures outlined in the WEM Rules. The Market Procedure on registration will contain further detail on the requirements for capacity that was certified to be presented for the purposes of scheduling and dispatch. For example, if a hybrid facility was certified for both its intermittent and firming components, both of these forms of capacity would need to be presented for scheduling and dispatch.[23]

The existing processes for suspension and de-registration do not require substantive change and will be retained.

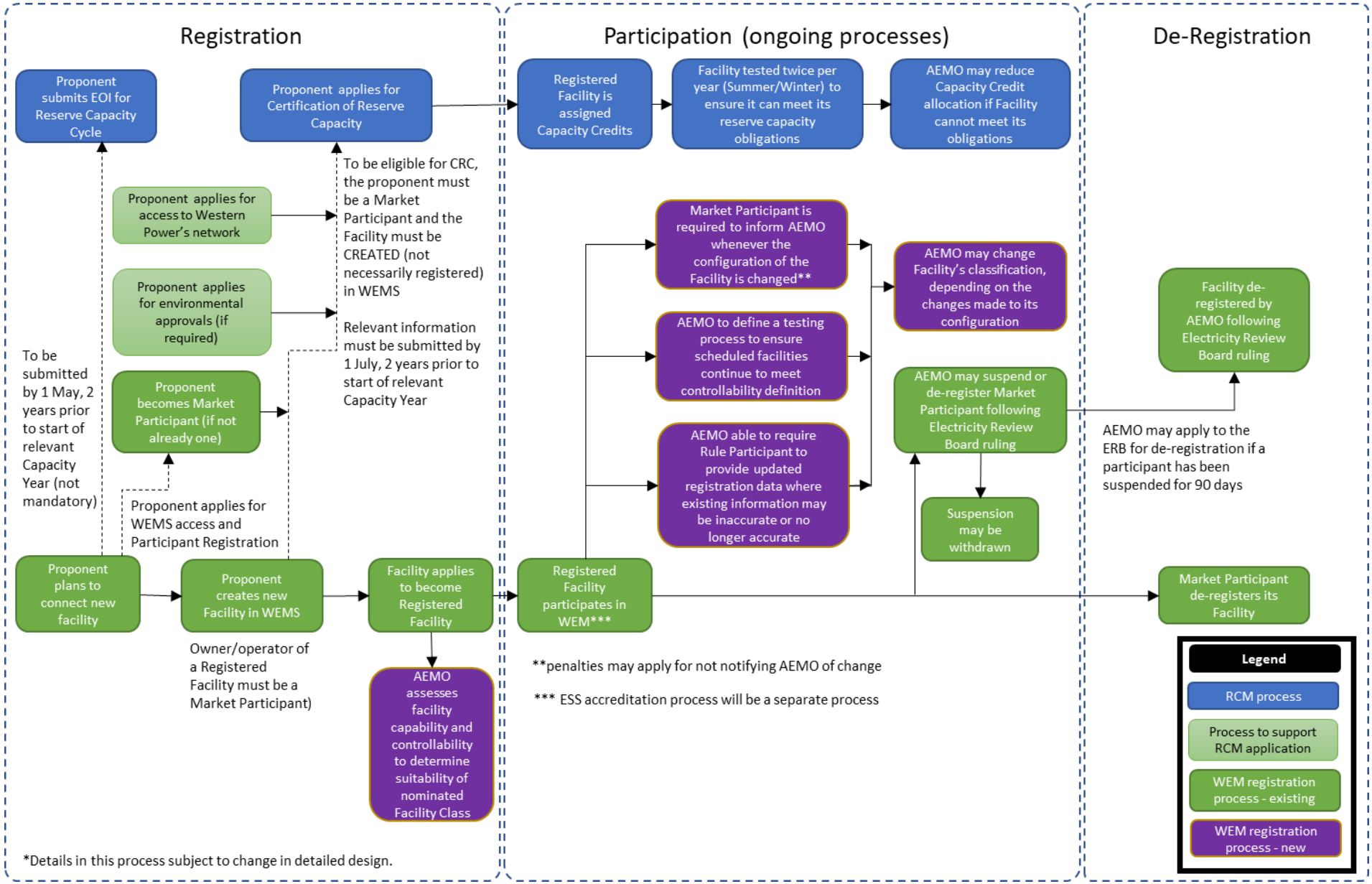
5.2 Taskforce Design Decisions – Registration processes

The Taskforce has endorsed the following design decisions

- Market Participants will be required to notify AEMO whenever the configuration of their Facility changes as this may affect the classification of the Facility
- DER facilities aggregated across multiple connection points will be required to notify AEMO of any changes to the connection points in their aggregation. These changes include a connection point switching to another retailer, a connection point opting out of the DER program, or a change in the network configuration such that a part of the Facility moves to a different zone substation (TNI).
- Existing processes for suspension and de-registration of Facilities will be retained.

[23] Further work is to be undertaken to determine any potential changes to the RCOQ concept, in particular, for hybrid facilities.

Figure 3 Facility lifecycle in the WEM



Existing and future technological configurations

Technology	Examples	Characteristics	Single or multiple connection points?	Direction of energy flow	ESS provision
Conventional generation	Conventional thermal generation	Can move up or down at AEMO's request and can control output over a sustained period	Typically behind a single connection point. However, can be behind multiple connection points at the same electrical location (e.g. combined cycle facilities).	Exporting. However, can also import when starting up (station usage) When co-located with a load, can import only or be bidirectional (net-exporting)[24].	Frequency control ESS subject to accreditation Non-frequency control ESS (e.g. locational)
Intermittent generation	Wind or solar generation	May not be able to move up but can curtail output at AEMO's request. Cannot (traditionally) control output over sustained period. However, in future, with improved forecasting accuracy, intermittent systems may be able to improve control of output.	Larger facilities will typically be grid connected with smaller embedded facilities on the distribution network. Typically behind a single connection point. However, system can be behind multiple connection points at the same electrical location (e.g. wind turbines). Aggregated DER may be behind multiple connection points also.	Exporting. However, can also import (station usage) When co-located with loads, can import only or be bidirectional (net-exporting)[25].	See conventional generation

[24] This is the current construct of intermittent loads.

[25] Offering in net exports from distributed rooftop PV would fall into this category (i.e. intermittent across (potentially multiple) connection points which import and export).

Appendix A: Existing and Future Technological Configurations

Technology	Examples	Characteristics	Single or multiple connection points?	Direction of energy flow	ESS provision
Standalone storage	Standalone battery or other energy storage system	Can move up or down at AEMO's request and can control output and input over a given period subject to its state of charge, storage (MWh) capacity and charge/discharge (MW) capacity Storage systems will be required to provide a real-time state of charge feed to AEMO, and will also be required to schedule their withdrawals via energy offers.	Larger facilities are likely to be grid connected and likely to be behind a single connection point Aggregated DER may be behind multiple connection points	Bidirectional - consuming when charging. When co-located with loads, can import or be bidirectional (net-exporting) [26].	See conventional generation Frequency ESS provision constrained by energy storage (MWh) capability[27]
Storage and intermittent generation hybrid	Intermittent generation paired with an energy storage system	Level of controllability depends on size of intermittent generation relative to the size of the storage system as well as forecasting accuracy. As with standalone storage, AEMO will require state of charge data, and the facility would be required to schedule withdrawals via offers.	See standalone storage	See standalone storage	See conventional generation. Although a storage hybrid system may be required to provide AEMO a real-time feed of its state of charge, the state of charge would not be a consideration in frequency ESS provision (as it is for standalone storage)

[26] Offering in net exports from distributed storage systems would fall into this category

[27] See Information Paper: ESS Scheduling and Dispatch

Appendix A: Existing and Future Technological Configurations

Technology	Examples	Characteristics	Single or multiple connection points?	Direction of energy flow	ESS provision
Storage and conventional generation hybrid[28]	Conventional generation paired with an energy storage system	Controllability is the same as that of a conventional generator. However, as with standalone storage, AEMO will require state of charge data, and the facility would be required to schedule withdrawals via offers	See standalone storage[29]	See standalone storage	See conventional generation
Loads - uncontrollable	Large transmission connected loads or loads at the distribution level	Consumes as required - AEMO cannot issue instructions to move up or down.	Can be behind single or multiple connection points	Importing	Could act as interruptible load if responsive to frequency

[28] A hybrid system comprising storage paired with both intermittent and conventional generation would have similar characteristics to a hybrid comprising storage and conventional generation.

[29] Storage paired with conventional generation is unlikely to be seen in an aggregated DER context.

Technology	Examples	Characteristics	Single or multiple connection points?	Direction of energy flow	ESS provision
Loads - controllable	Large transmission connected loads or loads at the distribution level	May be a Scheduled Load[30] which is required to respond within the dispatch interval and can move up or down (if at a single electrical location) or only down if it is at multiple electrical locations May be part of a (DSP) which requires a notice period of two hours and can only be curtailed	Can be behind single or multiple connection points. When part of an aggregated DER facility, could comprise dispatchable loads only (e.g. batteries, EVs, smart appliances), but may also be part of a configuration which contains generation components (solar PV and batteries) Can also be distributed across multiple electrical locations. However, a Scheduled Load at multiple electrical locations can only submit single offer tranches at the market price cap (i.e. curtailable only)	Importing	Could act as interruptible load if responsive to frequency

[30] See Information Paper: Energy Scheduling and Dispatch